

1st TERNARY MEETING REPORT
(2nd Quarterly Report)

TAMRF-BLM Contract AA851-CT1-55

29145

TAMRF-TAMU 4567

Program Manager
Dr. William Merrell, Jr.

Prepared by

Sylvia C. Herrig
Assistant Program Manager

and

Rose Norman
Project Editor

B LM Program Office
Department of Oceanography
Texas A&M University
College Station, Texas 77843

Submitted to

Dr. Robert Rogers, COAR
Department of the Interior
Bureau of Land Management
500 Camp Street, Suite 841
New Orleans, Louisiana 70130

March 1982

TEXAS A & M UNIVERSITY

COLLEGE OF GEOSCIENCES

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REGISTERED

Reply to
Department of
OCEANOGRAPHY
Telephone (713) 84 S-7211

March 22, 1982

M E M O R A N D U M

TO: Dr. Robert Rogers
BLM/ COAR

FROM: Sylvia Herrig *Sylvia Herrig*
Assistant Program Manager

SUBJECT: Ternary Meeting Report
(Contract AA851-CT1-55; RF4567)

Enclosed is a copy of the 1st Ternary Meeting Report, incorporating the transcript of the San Antonio Ternary Meeting. This ternary meeting report also serves as the 2nd quarterly report for the referenced contract.

Enclosure

SCH/kdd

cc: W. Merrell

DISTRIBUTION: **1st** Ternary Meeting Report, March 1982

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C. Day, CO (1 copy)
R. Grussendorf (3 copies)
R. Avent (1 copy)
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TAMU

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S. Herrig
D. **McGrail**
W. **Merrell**
R. Norman
R. Reid
R. Rezak
M. Carries
D. Home
File

TAMRF

G. Goodin
C. **Tolmsoff**

OTHER

L. Dauterive

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SUMMARY

1ST TERNARY MEETING

Contract **AA851-CT1-55 (RF4567)**

San Antonio, TX

February 18, 1982

ATTENDEES:

TAMU - **PI's:** Richard Rezak, **David McGrail**, Thomas Bright
 Program Manager: William **Merrell**
 Assistant Program Manager: Sylvia **Herrig**
 Project Editor: Rose Norman

BLM - New Orleans OCS: **COAR**, Robert Rogers; Robert Avent,
 David **Amstutz**

Other - Les Dauterive (Minerals Management Service, Metairie, LA)

Project ManagementWilliam **Merrell** and Sylvia **Herrig**Scheduling and Data

Bill **Merrell** reported that the project is on schedule and indicated that biological, physical, and geophysical data are still being processed preparatory to synthesis. Dr. Rezak is still seeking additional sub-bottom data, and a contract modification has been tentatively approved to allow deployment of current meters on a Texas A&M sponsored cruise scheduled for **March**.

Seminars

Merrell also indicated a tentative **re-direction** of emphasis in the synthesis seminar series. The first nine seminars followed a geographical approach, focusing on individual banks or groups of banks. The new approach will be process-oriented, beginning with a seminar on **zonation**.

Publications

A summary outline of the planned report was distributed (included in Appendix), and **Merrell** indicated that **PI's** anticipate publishing articles in scientific journals during the term of the contract. Manuscripts will be submitted to BLM for review before publication. To assure wide distribution of the overall results and conclusions, **PI's** are also seeking a book publisher.

1982 Meetings

Sylvia Herrig reported on two project-related meetings planned for 1982. The three Pi's will speak at the **Gulf-Wide** meeting scheduled for May 12-13 in Mobile, Alabama. A ternary meeting will be held in conjunction with the Mobile meeting. The third annual Information Transfer Meeting will be held August 3-5 in New Orleans. Arrangements **will** be handled by Texas **A&M**, funded by a modification **to** the Synthesis contract (**CT1-55**), and the three Pi's will speak. Presentations at both meetings are to emphasize recent results of technical studies.

Biology

Thomas Bright

Tom Bright reported progress in reassessing BLM data (1975-1980] on submersible observations of fish and vertebrates. Preliminary results of Bray-Curtis cluster analysis on East and West Flower Garden data indicate assemblages associated with depth intervals: 1) a coral reef assemblage; 2) an "algal-sponge" assemblage; and 3) a deep-water assemblage. The depth versus abundance data for these reef fish populations are unique. Similar analyses are planned for invertebrate populations.

Geology

Richard Rezak

Richard Rezak is presently seeking existing sub-bottom data on banks for which sub-bottom profiling was not done. He **also** plans to acquire existing seismic data between banks in order to develop a regional picture of unconformities. Most of the work on sediment distribution is completed, but he plans to **re-classify** Flower Garden sediments to produce a more meaningful sediment distribution map. Recent analyses **also** indicate the possibility of a previously unidentified facies at the West Flower Garden Bank, a **molluscan** hash facies. Additional samples to be collected on the upcoming University sponsored cruise should confirm this identification. Based on a large sediment sample collection donated **by** Tenneco, there is the possibility of updating the USGS regional sediment distribution map (Grady, 1970) .

Sediment & Current Dynamics

David McGrail

Work in progress focuses on isolating two-day period oscillations identified through time series current meter data. Wind data are being examined to see if this is a large scale feature. Work to be done on the up-coming University sponsored cruise will improve our understanding of the bottom boundary layer and will be crucial to the shelf circulation study.

MINUTES/TRANSCRIPT
 1st TERNARY MEETING
 Contract **AA851-CT1-55 (RF4567)**
 San Antonio, Texas
 February 18, 1982

ATTENDEES:

TAMU - **Pi's:** Richard Rezak, David **McGrail**, T.J. Bright
 Program **Manager: William Merrell**
 Assistant Program Manager: Sylvia **Herrig**
 Pt-eject Editor: Rose Norman,
 BLM - New Orleans OCS: **COAR**, Robert Rogers; Bob Avent,
 David **Amstutz**
 Other - Les Dauterive (Minerals Management Service, Metairie, LA)

1. DISCUSSION OF AGENDA
 Bill **Merrell**

The first item is the discussion of the agenda. What I would like to do is give a very brief project overview, talk about where we are in timing and indicate some redirection of the management aspect of the project. **Sylvi** will talk about a couple of the upcoming meetings. We haven't **talked** about them in awhile and need clarification. Next, **we'll** go over the progress and problems on this contract. The three major **Pi's** will report on their areas, and then we'll invite responses from the audience and try to agree on a necessary list of action items that might come out of our discussions.

II. PROJECT OVERVIEW AND MANAGEMENT
 Bill **Merrell** and Sylvia **Herrig**

Objectives and Progress
 Bill **Merrell**

Let me briefly go over the project overview and the management. According to the PERT diagram and project milestones (which are the first two attachments to the agenda) [see Appendix] , we are on schedule. Of course, when all you have is meetings, it's hard to evaluate progress. One of the things we have to remember on this project is that in addition to being a data synthesis project, there's a lot of data work-up associated with it. In fact, one of the things that makes getting together all the data a little more difficult is the fact that some of the data isn't here. **We'll** be talking about a bank and Rezak won't have a certain piece of data, or we'll be talking about something that Bright hasn't worked up. Also, some of the current meter data aren't worked up. We constantly have to modify because it's not a synthesis until all the data have been worked up and in a nice package. We also intend to collect data on this next cruise. Dr. **McGrail** will discuss that later.

Rogers: What about the biology part? Has all the data been worked up on it, theoretically?

Merrell: Well, you can talk to Tom Bright about that. [Bright had not arrived at the meeting yet.] I have the impression that much of it has

been worked up and that he's probably in the best shape to start writing. That's my impression from talking **to all** three of the **PI's**.

Rogers: He has so many video tapes that I guess he's constantly going over them.

Merrell: I have a feeling that of the data, the biology is worked up best to the point of doing synthesis, and the physical data's probably the worst at this point. There's more data work-up required, but there's more people working on the physical data too, so I "think **we're** where we thought we would be. It's just takes a lot longer to work up the current meter data. The physical data has been scanned for the major points that probably will interact with the synthesis. At least **it's** been looked at. The rough ideas on the physics are pretty much all done. Isn't that right, Dave?

McGrail: Yes.

Merrell: One of the things I wanted to particularly talk about is the approach that we had in the proposal and the approach that we've taken up until now. [It has been essentially a geographical approach, where we looked at the Flower Garden Banks first, tried to understand the East and West Flower Gardens and the interactions between the biota and the **nepheloid** layer and the various interactions--things that you need to do in a synthesis program. In the seminar series, we started out with the East and West Flower Gardens. I thought these seminars were quite successful. The principal investigators led off with a summary. Then we had a lot of discussion, e.g., why you have particular kinds of **zonation**, and we talked about the geology and physics and the biology of these banks. Then we essentially followed the proposal and started looking at different clusters of banks on the Texas shelf.

We began by looking at three banks at a time, and that did lead to some interesting discussions. I think we learned, for example, that we really need to understand the physical oceanography of the entire shelf as well as we can to ever look at the banks as a **total** system. Of course, this means almost exclusively working with data not collected by the BLM project because we haven't done any seasonal work except at the Flower Gardens. So we started going back and getting all the data that Texas A&M has on the OCS and all the fishery data. We've got that much.

At that point we decided we should redirect the seminars somewhat. I want to talk about this redirection, and the three Pi's may want to add some comments. We have so much data at the Flower Garden Banks (those are really the only banks we're ever going to come truly close to understanding), and it seems that instead of a geographical approach where you just take three banks here, and three there, and go down the shelf, what we ought to be doing is looking at some of the processes that control things at the Flower Gardens and trying to apply those to different banks on the shelf. So at our next seminar **we're** going to do that. We're beginning with the processes controlling zonation at the Flower Gardens. That will be the topic, and we'll talk about how the

nepheloid layer influences biology, how the different geological zones affect the biology, and vice versa. Of course, the biology has created some of these zones. It is an interactive sort of thing.

So instead of a geographical approach, we're **going** to try to get these seminars more oriented towards particular processes. We're going to try it with zonation. We don't know how successful it will be, but we felt that we would get more interaction this way than by just going through it from a purely geographical point of view and taking three banks at a time. It will be an experiment for the next seminar. I think that's a slight redirection of the project, but it's still pursuant to the contract, and we're still trying to get the same results. I think we've learned from our experiences in trying to work together. The meetings have been extremely important, and we intend to continue them.

Do you want to say anything about this? Tom, I think you were the one who first brought up that we should try this sort of thing.

Bright: Well, we really have a pretty good idea in each of our minds about what the biology is, what the physical oceanography is, and what the geology is at these various banks, but we have yet to really put these things together in some fashion that allows us to relate them to one another in a process-oriented context. This is what we want to try to concentrate on. We want to get together and discuss what our results are in relation to one another. And, as you said, the first topic we're going to approach is **zonation**. I have some preconceptions, but preconceptions are not always valid, so we have to get together and determine whether or not our preconceived ideas are real or not and whether we can support them or discard them. And that's the object. It's sort of a new departure.

Merrell: Well, it's not a radical departure.

Bright: Well, I think it directly addresses the objectives of the contract, whereas the other would simply be going over the same old stuff. So it's very appropriate.

Merrell: One of the handouts is a summary outline of what we think the final report should look like [see Appendix] . We thought we should get this together early so we could make sure that we're working towards clear objectives. I encourage you to read it over at your leisure. We are directing any writing towards this outline, and we're directing our meetings towards getting this final report done. **Hopefully**, this will be the outline of a nice book or something that we can see published that would fit closely with the final report and would have a wider distribution.

We hope to get a summary book out of this project as well as scientific publications on certain items. Of course, the book is not part of the contract; the final report is. We hope we will be able to have a final report that's of a quality to be published with some modification and be widely distributed. We have contacted some

publishers about that, and we fee! that getting this summarized and out in a broad manner would be very important, both to us, as scientists, and to the Bureau of Land **Management**. I think it would be a very handy management tool as well as an interesting scientific book, It would have essentially the same outline as the final report. Of course, the final report would probably have more detail in certain areas. We can't promise this publication but we have all agreed that that is something that we would like to see. Of course, whoever publishes the book would bear the publication costs.

Bright: We think this will be a much more visible expression of the results of the efforts that we've gone to than the BLM reports, which are really limited in circulation.

Merrell: BLM has put an awful lot of money and time in this research and will be assured proper credit as the funder of much of this work. I think it will be a very positive thing.

Amstutz: Do you still intend to periodically publish?

Merrell: Definitely. This is not a substitute for that. We will publish in the professional journals, and those publications will have a lot more data in them than the book will. The book that **we're** talking about will be more of a synthesis, although we will have summary tables and summary diagrams. Hopefully, it will read not quite as technically as a scientific paper. We will provide 'an introduction as to why we're doing this, etc.

Rogers: More colored pictures?

Merrell: Yes. Of course, that will depend on how much money the publishers are willing to put into color. **That's** really an economic thing and we don't have any control over it, although **that's** how we envision the book. Some fairly spectacular **color** photographs and tapes would look nice, and **we've** generated some very nice graphics. The **zonation** maps and these sort of things would go very nicely in the book .

Rogers: Different from the ones in the final report?

Merrell: No, essentially the **same**, but not all tables and data. That wouldn't go, but that may go in scientific papers.

I think there's a lot of interest in the **Flower** Gardens and there would be in the other banks if people knew more about them. I think this type of thing will be well received by the general public as well as by **fellow** scientists. If you're going to send something to the state legislature, it should not be a compendium of all of our publications, which **would** probably be looked at and thrown **in** the waste paper basket. This would probably be kept and looked at. It would be pretty useful.

Bright: The publications are now starting **to** come from this project. From 1979 to now, I can count four publications in refereed journals and one in a book.

Rogers: That's something that we'd like to keep track of that might be informative for your own use. **We'd like** to have a list of the technical articles that have come out of this project.

Bright: I have a dandy one that predicts the demise of the Flower Gardens.

Rezak: [n the second issue of Gee-Marine Letters; the title **is** "Seafloor instability at the East Flower Garden Bank. "

Rogers: This is coming out?

Rezak: **It's** supposed to be **in** print now. I haven't seen it yet.

Merrell: Of course, you'll get a reprint when they come in.

Bright: Things are really starting to **focus** now. It takes time for these things to come about.

Merrell: As soon as the physical data are worked up, **there'll** be more publications coming out. It's not as clear what formal publications will come out jointly offered by the three groups. We're not far enough along for that. But of course, there definitely will be quite a few scientific papers. The physical group has been outlining some papers.

McGrail: I'm doing a summary paper for an SEPM special publication on the shelf slope. ["Shelf Edge Dynamics and the **Nepheloid** Layer"]

Bright: I think Dick has some new really good information on the faulting and such at the Flower Gardens that didn't get in the other paper [i.e. , Gee-Marine Letters] . So, the publications are there, and they are coming. **I** think it's a good healthy approach toward consummating this whole effort. Within the next couple of years I think **we will** be able to look back on a bunch of publications, the book, some reports in your file.

Rogers: All that we ask on these papers is that we are given a chance to look at them ahead of time so there's no implications on oil and gas operations from this faulting process.

Rezak: This paper that Tom just mentioned comes from information that was in the last final report [CT8-35] .

Bright: Virtually the paper is in the Iast **final** report as far as this information is concerned. We don't comment on oil and gas.

Merrell: I think our job is to lay out the science as completely and accurately as we can and leave the implications to the decision-makers. We'll give them plenty of information and they can make the decisions.

You have the outline of the final report, and you have the project **timeline**. As I said, we may change our approach somewhat, but we will continue having seminars.

Amstutz: Are they open to the faculty and so on?

Merrell: Sure, anyone can come. Each "one of them has a theme and as I said, we are going to more process-oriented themes. We're going to see how it works. If it works 'well, we'll stick with it. if it doesn't, we'll try something else. I have not been displeased with them up till now; I want to make that clear. I don't think that will change. I think it will be nice if we can have some more process orientation in it, and a little geographical orientation once in a while. I think if we work on the processes more, sooner or later we'll have to look at the **whole** Texas shelf as a process, and that's going to be a tough problem, i.e. , understanding the distribution from one bank to the next. Much of the data just don't exist and it would be prohibitive to collect seasonal data on the shelf. We're looking at existing seasonal data.

Bright: I really think that, on the basis of historical data we collectively have, we can at least attempt to explain some of the distributions of the hard-bottom communities on these various banks. I feel like I've got some border regimes out there that must be different.

Merrell: Well, I have pulled every A&M cruise that went through there out of the file, and I've tried to get **all** the historical data together. I'm **giving** a special Problems course to one of Dave's students on everything we can find. But there never has been a program designed to understand circulation of the Texas shelf, so everything you get is hedge-podge and here-there. We can only go so far. For example, in the southern regions you see **upwellings** on the outer banks quite a bit, and you don't see them on the northern banks. When we give you the salts and the temperature you can derive implications on how that affects the **biota**. I think Dave's work on the sediment distribution is going to be very important in trying to understand the physical processes. We might get **good** means more by looking at sediments than we will by looking at current meter records.

I think it's all coming together. I don't want to act like we're going to understand circulation of the Texas shelf, but I think we understand a lot about what happens around the Flower Gardens, which was vastly different from what "w"e thought it was before we went out there.

Sylvi will talk about the meetings next. I'm going to leave the individual questions of the different scientists to when they very

briefly talk about what they're doing. Is there anything **on** the management that we should **talk** about now?

Rogers: You'll receive word soon on **our** decision on the modification for additional cruise work to further define your recent findings on the current going across the shelf. I think you have tentatively been given approval on it?

McGrail: Yes, it was a very strong tentative okay. The things he could guarantee me absolutely were that the modification would be written, and that all the equipment on the present contract would be carried forward on the new contract, and that he was sending forth a request for the time change we asked for. We had **to** recognize that there is a negligibly small possibility that somewhere someone could decide not to approve this.

Rogers: Everything now is subject to higher level approval. Since there's no additional money involved, he ought to be pleased as punch.

Merrell: I think it will be very useful data. When we took out the university ship for a student cruise last March and put the current meters out and did that survey for you around the Gardens, we were able **to** run a section all the way across **the** shelf which has been a very interesting section. But more of it will be necessary for us to understand what it means. I think we're really waiting **on** this new data for our synthesis work on the overall Texas shelf **data**. It's very important. I'm pleased it's gone so far.

Rogers: **You're** going out one time now to gather this additional information?

McGrail: Yes, **we'll** deploy the current meters and take **PHISH** stations across the shelf.

Merrell: Not pursuant to this, we also have a promise of two days of ship time **to** recover the current meters later on. We'll also take another **PHISH** section when we pick them up, if we can. We're pushing **A&M** pretty hard on this.

McGrail: We do have the Z transect, but the station spacing is too wide to give us the kind of information we need. The thing the cruise makes possible is that we can go back to historical data, look at the new sections across there, and try to get some perspective. We want to know what would happen if you were to drop closer stations across that shelf slope break. Would it be consistent with what we are saying now.

Merrell: We can now interpret some of those sections that we couldn't before until we had the current meter data with it.

McGrail: The **AGU/ASLO** paper 1 gave yesterday shows that the currents are clearly matching up with the temperature components.

Merrell: Now we can use temperature to look **at** the seasonal variation of that current. But now we only have that one section, and we need this other one. **We're** going to go farther down the shelf, look at it again, and we're going to moor long-term current meters in it, so we really ought to make a big step forward.

Rogers: So using this historical data, you think you could patch together the seasonal variations?

Merrell: We'll have a much better feel for it. I think Dave's long-term moorings at the Flower Gardens **also** give us an indication that a current is essentially there all the time. The historical data that I've looked at so far seem to indicate that, unless there's an event like a strong cyclone migrating through there or two or three hurricanes coming through there, the current is usually there.

Merrell: We had seen it before. In a 1960 technical report, for example, **McLellan** said that it's a semi-permanent feature. **It** isn't that people haven't observed it; they just never studied it in a coherent manner. **It** looks like it has a lot more transport than just the return flow off the Texas shelf, so it must be getting waters from the south. I think that current may have a real influence on why the Flower Gardens are the way that they are.

McGrail: Not just the Flower Gardens. **It's** significant with respect to the differences among the banks that lie inside and outside the front.

Merrell: Yes. It isn't the same waters; **it's** warmer.

McGrail: The temperatures are different, " the salinities are different, as well as the direction of flow.

Merrell: Also, it must have big implications just on the total shelf processes. If you have a strong current at the shelf break, you should **expect** different **processes**. **Or** if You have a reversal of flow on the **shelf** break, it would make a difference. I think it will be a very fruitful investigation.

Rogers: You sound like you don't have any concerns about the time it's going to take to analyze this.

McGrail: No, because as I told you, we're not going to be going through there and giving those records the kind of analysis that we have with the previous ones. Michael Carries is working **to** separate out the inertial and the tidal **signal**, etc. The **purpose** of this record is to look at the structure of **that** current over a 'relatively short period of time, six weeks, and to try to determine what's going on spatially in that setting. That's not going to be analyzed in the kind of detail and in the way we have for previous records. I **don't** really think that will cause any problems.

Dauterive: What kinds of data collection do you anticipate using for the synthesis beyond what you **already** have?

McGrail: On this upcoming cruise we're going to take transects out across the shelf from Galveston, beyond the Flower Gardens. We're not looking at the Flower Gardens. What we're looking at is the structure of this current. We're going to pick up a couple of sediment samples to fill out a distribution that Dick's looking at. **We're** going to be taking stations out across the shelf, then along the slope. We'll take transects back and forth across this current and set out current meters to bracket this current along the slope. Then **we'll** close off the box .

Merrell: Take another transect back further "downstream" from the Texas shelf.

McGrail: And then close that off. The data **we'll** be looking at are the current velocities, the vertical structure that we get from the **PHISH** stations, the temperature, salinities, transmissivity. **We** want to see what the sediment looks like on a larger basis. If we had not taken that original shelf transect, **I** think we would have had a hard time interpreting the differences in those banks on either side of that current. It really helps delineate what's going on.

Merrell: It turned out to be a good thing. **I** have taken a lot of transects out there, but the profiling current meter **{on the PHISH}** makes a major difference. The water is too shallow for **geostrophy** to really make much sense. You have to consider **geostrophy**, and we were quite worried. I was worried that the bump we were seeing in the thermal structure **at** the shelf break **might** not be associated with the current but associated just with the temperature difference from going to shallow water from very deep water. I've run that section through the Flower Gardens on student cruises three previous times, and we're able to go back to look at that data. Without Dave's system, we really never could understand what was happening. Now we can start using this historical data that we have collected but that was difficult to interpret for currents. We have some good temperatures; we just didn't have currents. We have an awful lot of other data from the historical section that we can now use. Anytime we go out, we'll go by the Flower Gardens because that's where the long-term data were taken. **That's** the region we understand best. When planning a section, it's always nice to touch base on the place you think you understand.

McGrail: If we find things at the Flower Gardens that we have seen before and understand, it makes us comfortable with other things.

Merrell: But if things are drastically different there, then you have to question what you're seeing everywhere else. If that's an anomalous flow, etc.

Audience: Is the bulk of that historical data just **XBT's** or something like that?

Merrell: Well he [H. J. McLellan] did it **by ship's drift** quite a bit. He did it just on some sections he ran that went all the way from Galveston to Campeche Bay. He repeated sections in there. At the time, we really didn't think about the **mesoscale** much. If you **go** back and look at his sections now you see large, strong **mesoscale** features. **It's** much easier to interpret that. **He** always saw that break at the shelf and inferred that it was a current, just as I have when I saw it, but **I** couldn't prove that it was a current. You don't know what the depth of no motion is or any of that until you get Dave's profiling current meter' out there. The depth of no motion there **is** a sloped depth of no motion. **But** with the profiling current meter, then **you've** got it. **I** think if we take another couple of sections, we will be **able** to learn a **lot** about flow on the Texas shelf. We need to understand that. This "Texas slope current," as I'm calling it now, would be very important in determining where oil from an oil spill **would** end up.

McGrail: For example, a current meter that broke loose from one of our moorings was picked up southeast of Mobile, Alabama.

Merrell: If you look at the shelf circulation, it could never get there. **It** could never get there if you used the classical idea of the circulation on the Texas **shelf**. It would have to end up in Corpus Christi, where everything else does. But this one was far enough out to be in this eastward running slope current instead of the westward running **shelf** current. The break is **right** on the slope, and it went the other way. Evidently, it's **always** going to go the other way if it's deep **enough** in the water column not to be wind blown. Every time we've looked, we've seen this current. The **only** time I've seen this current broken down was in 1962 when there was a very strong cyclone impinging on the Texas shelf and it seemed to break everything down. You don't see the slope current then.

McGrail: In April of 1979 when we went out there, there was a very strong westerly flow.

Merrell: Yes, I suspect that was a cyclone.

McGrail: There were no weather-associated phenomena.

Merrell: As we understand the deeper **mesoscale** circulation better, we're saying that, as well as the warm core rings coming over the western Gulf, **we're** seeing cyclones associated with this. I've gone back and looked at five old Gulf cruises, and **I've** found cyclones in every one. So it's not **an** unusual occurrence. Of course, that would give you a couple of knots in the other depth value, so this current is really an important thing. I think **we'll** come quite a way toward understanding the Texas shelf with this extra data.

Amstutz: Will this extra data be analyzed in the time frame of this cent **ract**?

Merrell: Yes. For what we want it for. Three years from now, we may be using it for other purposes, such as determining how energy goes down due to a front that came through or something.

McGrail: We have the **PHISH** set up now so that we will have most of those stations worked up (plotted and corrected] by the time we dock.

Merrell: I might add that was one of the reasons we pushed so hard for this; Dave's **PHISH** system is a remarkable teaching tool on a student cruise. When you see real time, temperature, and currents at the same time, the students see **geostrophy**. It's the only time you can say, "here's the slope of the isotherm, " and we plot that up on board the ship.

Audience: I see what you mean.

Merrell: [It's a different ball game. It sure helps us make intelligent decisions while we're out there as chief scientists. It makes a tremendous difference in physical oceanography. You used to just lay out a reasonable pattern and go do it as fast and as efficiently as you could. Now we're going to go find where that current is, and we know we're going to find it this time. Every other time I've been out there, I've just had to go where I thought it was; now we're going to know where it is. It's a different technique, and I think it's very important to train the students in it, so that's why A&M is putting up quite a bit of money.

Rogers: This is really a unique instrument, isn't it? I've noticed in the presentations, nobody else is using it.

Merrell: I think that's why Dave's been able to make so much progress. For the shallow waters it's imperative that you get currents as well as the thermal structure, and the salts of course.

McGrail: In that tracking site you also get sediment, and that's really important.

Bright: This instrument does belong to Texas A&M, right?

McGrail: Yes.

Merrell: It's a very nice instrument, and I think it's going to help us understand the Texas shelf. In fact, it's the type of instrument that ought to be used in any sort of shelf study.

Rogers: I was just surprised that more people weren't jumping up and down, when you gave your presentation, asking how you got that data. Do they really understand what the **PHISH** is?

Merrell: I think people understood. Most of the group who have been around have already seen the presentation on the **PHISH** system.

McGrail: One fellow was amazed at how quickly we took stations. It's only because we have the inclinometer in the instrument, so we know its orientation, **that** we can drop it just as fast as we want to. The EMCM has a cosine response, and if you know its orientation (fortunately it's not varied by more than about 5° from vertical; it rejects all the vertical motion), the only thing it picks up is the horizontal current. **Since** we take so many sweeps as we go through the water column and we get at least three shots a metre, it takes about 10 minutes for a profile in 100 **metres** of water. With the Loran navigation we use, we're able to tell the ship captain when we're coming up on a station, and to shut down the engine, turn it into the sea, and stop. The captain is just doing what we tell him to do. From the time we tell him that until time to go back to full speed is about **15** minutes at each station. The longest thing **we** have **to** wait for is the five minutes for the reversing thermometer to **equilibrate**. We're feeling so confident about our temperature sensors, we may start using reversing thermometers on only every third station.

Merrell: There's no problem with the temperatures. Salts are a problem, but temperature now, even on the **CTD**, is so good it's hardly worth even using the reversing thermometer. So, it will **be** faster without it; you could do it in 10 minutes. I was very impressed the first time we took it out.

Rogers: James **Stasny** [who designed schematics for **PHISH**] is no longer with you now?

Merrell: No. James **Stasny**, who I thought was the best electronics technician in the field, is now (because of the oceanography pay scales) the guy who repairs all the video games in town.

McGrail: James will be coming down and helping us set up for the cruise.

Rogers: I was wondering if you were missing him.

McGrail: Another technician is stepping in who has worked with **Stasny**. We'll manage.

Gulf-Wide Meeting (May 12-13; Mobile, AL)

Sylvia Herrig

Herrig: There are two meetings coming up, away from Texas A&M University. The first is in May and it will serve as a ternary meeting for the latest contract [**CT1-55**]. In talking to Bob, I understand it to be a progress type meeting; it will cover the East and West Gulf. It will be Gulf wide. I've never been real sure what meeting this coincides with.

Merrell: This is the Mobile, Alabama meeting, right? What is this going to be, Bob?

Rogers: This is sort of a new series of progress meetings that we've initiated within the last year. The first was held in Tallahassee, Florida. [It's **really** for the information of state agencies, our intergovernmental planning committee, and other federal agencies, particularly in the area where the meeting is held. Before this meeting, **BLM** people are going to meet with the state people and give them introductions to our whole studies program and the general plan of what the studies set out to do. We've found in the past that when you give the technical information, many people aren't familiar enough with the program to know where you're coming from, **why** the study is being done, and so forth. The day before you give these presentations, we will have met with them and given them some background, not technical background that you'll cover, but why the study is being done. So that will set the stage for you to present the latest findings on the study.

Herrig: Since **Rezak**, **Bright**, and **McGrail** are to **give** presentations, and presumably since the draft of 4260 [CT O-25] will be in to BLM for review if not back to us by then, their presentations will be in essence an overview of what they've found?

Merrell: To date?

Herrig: For the final report on **CT0-25**. " Because there won't really be any findings for CT 1-55.

Rogers: Well, it's a progress meeting on your latest findings. They will not **be** interested in what's happening on one contract as opposed to another.

Merrell: So, it's an overview presentation by the three scientists on the science that they're doing.

Rogers: Exactly.

McGrail: Is the audience going to be highly technically or mildly technically oriented?

Rogers: Yes, all of the above. Everybody is invited to this meeting. Mostly **it's** state agency type people -- Department of Natural Resources, Department of Economic Geology -- those type of people. This will be just like an Information Transfer Meeting, with discussions on technical results, and if you can, management implications. They like that; what's the **relevance** of these results? Do keep in mind that a lot of these people aren't familiar with the program, so don't just start talking about your latest findings without giving some point of reference about the technical findings that have led you **to** continue this way of thinking.

Rogers: A letter is coming out real soon (I have a copy now) from us to the Contractor. These meetings were originally set up in the Eastern Gulf, so the biggest contractor in the Eastern Gulf, which is **Woodward-Clyde** [Orange, CA], is the sponsor for this meeting, like you

are the sponsor for the **I**nformation Transfer Meeting in New Orleans. So you will be getting your directions from Woodward-Clyde, or from our office. There's always a discussion on how we should handle it.

Avent: **I** didn't get a chance **to** see Murray Brown's letter before the mailing. I don't know exactly what each one said, but travel arrangements and the meeting itself are being set up by Keith **McDonald** with Woodward-Clyde. And as for specific instructions for presentations, **I** think Murray **is** giving them from our office.

Rogers: **We're** just telling you what kind of directions are being given to the Contractor from our office. It is important to note that the theme to be developed during the studies meeting will be recent results rather than rambling and awfully lengthy presentations.

Bright: How long should the presentations be?

Rogers: You should not devote more than a few minutes to description of the overall program, as this already will have been covered.

Avent: If you can put your talk into the context of what we **will** have told them a day or two before. . .

Rezak: Are you going to tell us what you tell them?

Avent: Yes. We **will** give them some basic information on what contracts have gone on in the past, what kinds of studies go into each one, so they'll have an overview **of** the program. If you can give them a historical perspective--where that particular program is cubbyhole within the regional studies plan--then you can go ahead with your technical paper.

Rogers: Time will be a critical factor since there will be over **15** presentations. The presentations should **be** timely, relevant, and interesting. Visuals and handouts are encouraged. Going by Dave **McGrail's** presentation today, **I** would say that would be ideal for this meeting, with a little more background.

Bright: So you have 15 presentations in one day?

Rezak: **I** thought it was two days.

Merrell: A mundane management question, now that we have established that this **should** be interesting, is who is going to pay the travel?

Rogers: This should be taken out of your budget for the ternary meeting. This will include travel to Mobile and all the associated costs.

Merrell: We'll work that out. Now, the next meeting.

Information Transfer Meeting (Aug. 3-4; New Orleans, LA)
Sylvia Herrig

Herrig: The next meeting is to **be** held in New Orleans in August. It will be the I nformation Transfer Meeting with which everyone is **familiar**. This **will** require a contract modification; this won't be out of existing funds. **We** already have a hotel tentatively set up, which is the **Holidome**, by the airport.

Rez ak: Will the audience of the Information Transfer meeting be the same audience we have for the Gulf-Wide meeting?

Avent: It will overlap considerably.

Rogers: Yes, this is more of a general meeting of people involved in **all** our studies. **i** guess you can say the audience is more general; the **Gulf-Wide** meeting **is** more" oriented **to** Alabama and adjacent areas.

Rez ak: What **I'm** thinking is that there is not much time between **May** and August, and we're going to **be** saying pretty much the same kinds of things, aren't we?

Rogers: Yes.

Bright: **Do** you want essentially the same presentations at the two meetings?

Rogers: Essentially, yes.

Rez ak: **Will** there be **more** time at the I nformation Transfer meeting per speaker, or less, or the same amount?

Avent: They are both Gulf-wide, **so** essentially there **will** be the same number of papers.

Rogers: What **we're** thinking of is going back to the format of the first year, i.e. , concurrent sessions. We'll break down into smaller rooms so that the people there will be those interested in your particular area. These will be more informal. I think it was a better format for an exchange of ideas.

Herrig: So, just one main opening session and a closing session.

Rogers: Yes, that's right, and then we'll have the separate sessions.

Herrig: We had already tentatively arranged to have about ten conference rooms.

Rogers: We're very structured now in our generic description of studies. Have you received our most recent User's Guide?

Bright: **I've** got one.

Rogers: Well, pass that around. We have divided our OCS studies into generic topics with the specific programs falling under them. The eight generic topics are coastal characterizations, cultural resources, effects of oil and gas activity, endangered species, habitat mapping, marine ecosystems, physical oceanography, and recreation and fisheries. We would like to break down the groups by those eight generic topics.

Bright: We fall within what? Marine ecosystems?

Rogers: Yes .

Avent: We'll just go ahead and send you three copies of the User's Guide.

Herrig: Will we get a request for a contract modification?

Merrell: What about funding?

Rogers: To Mobile?

Merrell: Yes. Will we have just the three speakers go over?

Rogers: Yes. This should just be your **three** speakers.

Merrell: But that will count as a ternary meeting? The ternary meetings are contractual requirements. . .

Rogers: Yes, we will informally get together to discuss contractual matters. The other federal agencies that we bring in as part of the program will be there to hear the technical presentations only. That will keep them informed, so it does fulfill **all** the requirements for ternary meetings.

Merrell: Okay, but we **won't** have something like this meeting with Sylvia, Rose, and myself?

Rogers: Not formally. We will **get** together, but we won't bore everybody else with all the details of **the** contract.

Merrell: I'm not going to be there. We really **can't** afford to send six people.

Rogers: Okay, that was implied. Since we are having the other meeting in August.

Merrell: I'm not worried about us not being together enough. I'm worried about fulfilling the contractual requirements and not missing one of our contractual requirements.

Rogers: As to the Information Transfer Meeting, I'm sure **you're** concerned about the modification to provide for it. That is well in the works now.

Merrell: Yes, we are concerned.

Rogers: You've had a positive go-ahead from the Contracting Officer. **It's** not the same mod as the cruise addition, but it can be.

Herrig: It **shouldn't** be. That would cause a delay.

Rogers: They can be processed at about the same time.

Merrell: Ok, it's going to be the same mod.

McGrail: Yes;

Herrig: They will come through at the same time?

Rogers: That's not in the immediate plans and it could slow it down. There's a different time scale; you have to have your cruise modification written off immediately.

Merrell: Okay, lets keep them separate then.

Rogers: Well, I'll talk to Carroll Day and see what we can arrange on that. It might be possible. But there's money associated with this one and there's not with the other. it's got its problems.

Herrig: **Well**, we would like to **do** that mod for the August meeting as soon as possible,

Rogers: Right, and as I said, it's well into the works and you ought to know very soon about it.

Merrell: That finishes the project overview and management portion of the meeting. I propose a 10-minute break and **we'll** deal briefly with the remaining items, and finish up this morning.

III. BIOLOGY T.J. Bright

Bright: As far as the **old** project is concerned [**CT0-25**] , we have completed the reports on **coral** population levels and coral growth. We are still working on the report on **coral** recruitment. That should be completed within the next two or three weeks. I believe that will essentially complete our obligations for the **last** contract.

For the synthesis [**CT1-55**], what I have started is a reassessment of the data that we gathered with the submersible, with an approach that we have never been able to take before because we have never had enough time. We've gone back to all the old submersible transects and notes, all the observations of fishes and vertebrates with the depth and positions, etc. , out of the original transcripts, and entered this into files in the large computer at the university. For the fish, we've got about 1, 100 specific observations or stations and approximately 14,000 individual fish observations. I have grouped these data into five-year depth intervals for each of the banks and have run a Bray-Curtis cluster analysis on the data by these intervals

to cluster these out into some similarity clusters using the species and the abundance of that species within each of these five-year depth intervals at all the banks.

Avent: Bray-Curtis doesn't require abundance does it?

Bright: Bray-Curtis considers abundance. We used both species and abundance. And we clustered these out for the East and West Flower Gardens and for all the banks together. I was very pleased with the results. I've "brought some of the cluster diagrams with. me. Essentially the results confirm very nicely our preconceptions about the **zonation** of the banks. I was frankly surprised that the fishes clustered out into these depth intervals.

Just preliminarily, I've got some excellent clusters at the East and West Flower Garden. All of the depth intervals between 20 and 55 metres cluster together. All of the depth intervals between 60 and 90 metres cluster together. And all of them beneath 97 metres cluster together. You have some very nice overlap areas where the clusters share. So we have virtually a coral reef assemblage of fishes; we have an overlap zone; we have what I call the algal-sponge assemblage which is coincident with the algal nodule terrace; and then we have a deep water assemblage of fish. These clusters. were done with a 95% confidence interval. It looks like the fish reflect these zones very nicely, at least at the Flower Gardens. We've done the same thing for all of the banks together, and essentially the results' are predictably about the same. It's a bit less distinct because all the banks have been lumped together. I suspect that this is because at the various banks the depth limits of the zones vary. When I totally finish with this, I intend to look at it more closely and see what correlations there are within bank groups that are structured more similarly in terms of relief and distribution of the invertebrates. That's the next step. We're going to do this whole thing also for the invertebrates. There's a lot more invertebrate information and a lot more observations, and we are just now putting the data into the computer.

Rogers: You just picked out your most common species of fish?

Bright: I used everything that I recognized, everything that I knew I had recognized. I didn't include things that were questionable observations. We went through the first time and did the cluster analysis, and then looked at the results and made the decision as to what to remove from the data and do over again. Essentially, what we thought could happen is that some very rare species could unduly influence the clustering. This is common with cluster analysis. We went back and eliminated all the fish with less than 19 individuals, and eliminated all the fish that occurred on fewer than three banks; we threw those out. We also threw out the obviously large schooling species, and everything above 20 metres depth, which is about the crest of the shallows of the banks. We ran the clusters again, and it came out essentially the same. There's a very strong tendency for these things to be grouped into these depth ranges in terms of species position and abundance.

I've given the data that we have on the snappers and groupers to Benny Gallaway with LGL for use on their project, which is a roundabout thing ultimately funded by BLM through NOAA. Anyway, I gave him all the information we had on snappers and groupers in case he wants to use it in his study of snappers and groupers at the Flower Gardens.

I want to mention another thing I'm going to do. There are, I believe, probably about 115 species. I've plotted their abundances by depth on sheets, and these will be the beginnings of some figures or diagrams which I think will give us an interesting picture of the depth distribution of these fish. This is unique data because "when you go out and sample fish with a trawl or if you were fishing with hook and line, you would get adequate depth information, but you don't have the kind of control we've got with the direct sightings. So we've got some very good depth versus abundance data which I think will be unique with these reef fish populations.

We're going to do the same thing with the invertebrates and see how that fits with our preconceptions of the community distributions. I'm specifically interested in a refinement of the data we have on the distribution of corals and, even more specifically, coralline algae. I feel that the bottom depth limits of the coralline algae (their trailing off in abundance, so to speak, to nothing), is going to be a very important indicator of control on the distribution of hermatypic coral species on these banks by hydrography, the sedimentation, and by the nepheloid layer. So we're paying particular attention to the coral line algae and their abundance and distribution on each of these banks. And we'll refine that as much as we can.

Rogers: Do you have that information on most of the banks?

Bright: Yes. This is data that is quantifiable now. We have time to quantify it now. It was not quantified to any great extent in previous reports, so it's a new thing that we're doing. It's turning out to support the contentions that were made in past reports on the basis of individual impressions and so forth. I think that's where we are right now in biology.

Merrell: Any questions or comments?

Dauterive: Are you going to try to set up a system whereby if you have limited information on some bank or banks (identified through geophysical work but no biological data) you can put them into patterns with other banks?

Bright: We have several banks where we just don't have adequate biological information. I can't do cluster analysis on these. However, on the basis of the results of this kind of information, and our conceptions and knowledge of how the organisms are distributed on other banks, I'm pretty sure we could classify any of the banks that we don't have biological information on. At least we can guess what they harbor in terms of benthic communities.

Audience: How do **you** see banks that you don't have any biology on, for example, **MacNeil** and 29 Fathom. You **have** the **bathymetry** on **MacNeil** and 29 Fathom. They seem to be in the same shelf area. How do you see those particular banks in terms of classification?

Bright: **What's** the relief on **MacNeil**?

Rezak: **It** has pretty good relief. **I** can't recall now what the shallowest depths are.

Dauterive: 34 metres.

Bright: I have nothing biological on that.

Rezak: It is southeast of Coffee Lump, just north of the East Flower Garden.

Bright: **What's** the crest depth?

Dauterive: 62 metres.

Bright: 62 metres with **34** metres of relief.

Rogers: It would be an interesting one to use your predictive capabilities with.

Bright: On the basis of what we've got, **I** would predict there would be an Algal **Nodule** Zone, and at least sponge types.

Rezak: Also, the sediment type on there. ought to be similar to what we see around Coffee Lump.

Bright: Depending on **it's** position offshore, it should have some elements of the **Algal** Nodule Zone, Algal-Sponge Zone. It might have what I've been calling partially drowned reefs (for want of a better term) , surrounded by sand, **coralline algal** crust, leafy algae, and so on. It could be within a range of possibilities, but certainly it's going to have **viable coralline algal** populations of some sort, either in the form of nodules or crusts on hard-bottom. So it would fall within this classification.

Dauterive: **You'd** put it in A-IV? [Maximum protection; Algal-Sponge] How about **29 Fathom** bank, on which you don't have any biology? It's also in **that** same area.

Bright: **Is** that the same kind of crest depth as **MacNeil**?

Rezak: It's shallower.

Bright: The surrounding depths are what?

Dauterive: I think its base is **at** 64 m and it crests at 52 m.

Bright: That's a different story. That could possibly be something like Fishnet **Bank**. Probably some **coralline** algae but probably not a very robust population.

Dauterive: They monitored that in connection with some drilling, and took some photographs.

Bright: Photographs from the surface or even by divers who aren't experienced biologists don't give me enough information. I've seen some of these. They sent divers down and took photographs, but there just wasn't enough there to tell anything. In places, there could be the kind of organisms they took photographs of, and yet they could have missed a great deal of the **benthic** community.

Dauterive: [It doesn't fit in the pattern of these other banks, obviously, based on the depth of the bank and the relief and the general information.]

Bright: If you're really interested in trying to figure this out, sit down with me and think about it more precisely. Because if you're going to take away from this conversation some concrete ideas about what's on these banks, I don't think that's appropriate. I think we have the information and the feeling and knowledge that's necessary to predict what's on these banks. We can make an educated guess for sure.

Dauterive: One of your primary objectives of the synthesis is to try to set a pattern for those banks that you have limited information on?

Bright: If you could do that, then in order to confirm that, you're going to have to go out and take some kind of observation. But you can design the observations in such a way that you will have confirmation, if it's confirmable. But just randomly saying you're going to go out there and take a few photographs and come back and look at them and say what's on the banks, this is a sloppy way to go about it. I know that the Continental Shelf Associates did two banks, and their results were exactly what I would have predicted for those banks. I think the predictability is good for the northwestern Gulf.

IV. GEOLOGY Richard Rezak

Rezak: As far as the old contract [CT0-25] is concerned, I'm still in the process of writing. I have work copies of structure maps and the seafloor roughness maps with me if anyone is interested in looking at them. These were constructed from data that was collected in 1976 and 1977 that was never looked at.

One of the things that's in the new contract is for me to acquire some existing data to fill in gaps in this older data. Early on there was no requirement for **subbottom** profiling, but when we had profiling gear aboard, we ran it just to get the data and it didn't cost BLM

anything extra **at** that time. So on some of the banks, we don't have any **subbottom** information at all. On some **of** them we have limited information, and I know there is data available in your files and also Henry Berry **hill's that** would be helpful in categorizing these banks structurally.

One other thing **I** want to do is to get some seismic data between banks to try to tie unconformities that **I** see in various banks together in a regional picture. Our coverage is limited to the bank areas. Between-bank data will let me identify regional unconformities and **will** give me a handle, I think, on the amount of mobility of the structures over a period of time. Some of the unconformities are certainly going to be local, and they probably are due to local uplift rather than major sea level changes during the Pleistocene. So this is something **I** still want to do on the synthesis contract, which **we** are really just beginning to work on now. This idea of historical mobility **would** give us an idea of what the future prospects for mobility really are on various banks and maybe a handle on which banks are in some doubt as to whether or not it would be safe to put a structure close to them.

We've done most of the work on sediment distribution that is going to be done, except that **I'm** not really happy with the classical type of analyses that we've done. Dave **McGrail** and I have been discussing this over a period of time. One of **Dave's** students is looking at sediments around the Flower Garden Banks and **trying to get a** handle on the quartz composition of the sediments. We classify the sediments according to Folk's classification, and we get sands and gravels. A lot of these sands and gravels are carbonate shell hash, which really don't tell us much about where the sediment came from or its relationship to hydrology because these things have formed almost in situ with the carbonate sands and gravels. So we're looking at percentages of sand in samples and also we're going to be looking at heavy mineral composition--where do these things come from: from the Mississippi, from the **Brazos**, or what have you. I think we will be able to **tie** the sediment distribution into what Dave's been doing, as far as currents are concerned, a **lot** better than we were **able** to with the analysis that **we've** done in the past.

McGrail: Dick, how large is the Tenneco collection? How many tons of sediment data? Is it 6 tons?

Rezak: I think it is somewhere between 4 and 6 tons.

McGrail: So we have between 4 and 6 tons of 2-pound samples. What we're doing is selectively taking some of those that fill in the areas. That gives us an incredible data base.

Rezak: We're also looking at the samples that we've already collected and that we have on file around the East Flower Garden Bank. The West Flower Garden Bank is a **little** more difficult because it was sampled back in the late 1960's and **early** 1970s by Serpell Edwards, one of my students, and there's no raw sample left. **We've** got slides that he had prepared and impregnated materials. So we aren't able to look at the

quartz in detail in the immediate vicinity of the West Flower Garden Bank other than the few samples that we've collected for the BLM contract.

In the last report that you got [March 1981; CT8-35] , we identified a new facies at the East Flower Garden Bank, a **molluscan hash facies**. For some reason it was restricted to the western side of the bank. I wondered why we didn't see it at the West Flower Garden Bank, and I **think** the reason for that is that Edwards' sampling was closer in on the West Flower Garden Bank than the samples that we took **at** the East Flower Garden Bank. I have looked at **his** thin sections and I think in a couple of samples I see the same kinds of concentrations and particle types that we found in the East Flower Garden **molluscan hash facies**. So it may also exist at the West Flower Garden Bank. Dave's going to pick up a few more samples for me on this cruise to iron that out.

Dauterive: I have a question on the East Flower Garden Bank. In this technical proposal, you talk about the collapse of the East Flower Garden. You say in here that you are going to review the 1957 and 1975 **bathymetry** of the East Flower Garden.

Rezak: Well, I'm hoping that I can; I'm not sure that I can find tracks that will be exactly over our track s... .

Dauterive: Any observations in terms of how much collapse has taken place?

Rezak: in the paper that Tom **Bright** and I have written, Tom speculates on the amount of collapse based on the difference in coral growth rates. ["Seafloor instability **at** the East Flower Garden Bank, " Gee-Marine Letters, 1(2), 97-103]

Dauterive: Is there any effect on the biology or is it a very gradual thing that is not affecting the biology?

Bright: Well, **that's** very hypothetical. Eugene **Shinn** and Harold Hudson went out in 1980 and drilled some holes in coral heads. They did growth rate determinations on a dozen cores, and they came up with what appears to be a statistically significant drop in growth rate (approximately 1 mm/yr) of one species of coral since around 1957. [See also Hudson, J. H., 1981. Growth Rates in Montastrea annul aris: A Record of Environmental Change in Key Largo Coral Reef Marine Sanctuary, Florida. Bull. Mar. Sci., 31(2), 444-459.] It is possible that if there were a collapse of some sort that this could have brought on the decrease in growth rate of the coral. This is very iffy. It **would** have taken a collapse of several metres to do it, I would think. Corals are funny. They adapt; they adjust to the conditions that they **live** in. As far as their growth rate is concerned, it would seem to me that by this time they would have **re-acclimated**, possibly, to that degree of increase in depth. It's all very unclear as to whether or not this may have impacted on the growth rates.

Around the periphery of the base of the main reefs, we **also** see structures which 'bear **communities** of corals that are comprised of only six or seven species, whereas **higher** up on the reef, you have eighteen or so. The substratum on which the low diversity reefs grow **right** now gives evidence of being comprised of species that were not there previously. In other words, it's possible that subsidence has occurred, lowering a high diversity reef to a level below which the majority of species will survive, leaving only five or six surviving species. We **haven't** had an opportunity to examine the substratum in enough detail to determine what the historical composition of the corals was. But there are these bits of evidence that indicate that possibly something, and possibly a subsidence, has occurred there resulting in a decrease in growth rate of corals and a change in the species composition and diversity of the reef which has sunk. Parts of the reef have been transported below the depth that **can** support a high diversity reef, but it's all speculation.

Rezак: Structurally, it looks as though there's a displacement of about 8 to 10 metres.

Bright: We figured about 7 metres would be enough to affect coral growth.

Rezак: I don't know whether that all occurred at once or whether it occurred **in** stages.

Avent: Where does that information come from, historic charts?

Rezак: No, this is from high resolution (3.5 kHz) records.

Bright: **There's** a graben in the middle of **the thing** there, and it looks like about 7 or 8 metre displacement.

Dauterive: The displacement has occurred over what time period?

Rezак: We don't know that. Well, the date of the change in coral growth rate was 1957. If there's a correlation.

Bright: At this stage, with the information we have it could be nothing more than hypothetical. One of the things Dick and I would love to do is go back out and drill some more holes in Montastrea annul aris. I **would** like to go down and take a closer look at the substratum directly adjacent **to** the reefs and see what it was comprised of.

Rezак: This is another area on which I would like to get some additional sub-bottom data. Our 3.5 records are not really that good, and I would like to see some **boomer** or mini-sparker records over the same structures. The structures are large enough so that I think probably there have been other lines across them.

Bright: If we were to go out there and drill holes, then we would be able to possibly determine whether or not there had been a true change in growth rates in this area where the graben is.

Rezak: That graben is based not only on my 3.5 kHz records, but also on records that Henry Berryhill has. We were able to lump the two sets of data together on the map. I took his faults off the compendium map that he drew (the structure map), and they're continuous.

Avent: Have "you gotten some of the data from USGS?

Rezak: Not yet I haven't. I plan to go to Corpus Christi and talk to Henry Berryhill and see his records and get some copies. I also want to visit your office [Dauterive] and see what you have on the other banks in particular.

Avent: When would you want to make that trip? I need to go over there myself.

Rezak: Where, to Corpus Christi?

Avent: Yes.

Rezak: How about mid-March? Either before the 12th or after the 20th. How's that with your schedule?

Avent: I'll have to look at it.

Amstutz: I have a question on your sediment collection. I learned recently that the Bureau provides for the preservation of collections; for example, in biology there are a number of specimens kept in the Smithsonian. When David mentioned the magnitude of your sediment collection, it prompted the question of whether there will be time to archive after this work is done?

Rezak: We've got some samples left from the East Flower Garden Bank from the BLM program. On all the banks we only took four samples at each bank. Generally north, south, east, and west of the bank.

Amstutz: So, it's not of a magnitude that we have to worry about.

Rezak: No. The Tenneco samples were given to us by Tenneco, and we're archiving those. If you want the BLM samples or what's left of them after we get through, we'll be glad to transfer them.

Amstutz: Well, I didn't mean it that way. But it's a valuable collection. Somebody should provide archiving.

Rezak: The study that Dave's student is doing right now is going back to not only the Tenneco samples but to samples that we've taken on the East Flower Garden under our BLM contracts. This sort of thing could probably go on for a number of years. Different students might have

different ideas on what they would like to do with the sediments and there will be continuing studies on them.

Rogers: The Tenneco samples were originally for the **Coccolithophoric** distribution studies.

Rezak: That's right. I had originally hoped that we could update the USGS map [John R. Grady, 1970] on sediment distribution, which I still think needs to be upgraded. I've looked at certain blocks out there, checked the sediment type based on Grady's map, and then looked at foundation borings in the same area. The sediment is quite different.

V. SEDIMENT & CURRENT DYNAMICS

David McGrail

McGrail: Michael Carries has gotten the program from NOAA to take out the tidal signal. Apparently this program has been used by NOAA for quite some time. That's going on right now. He is using that on the currents to pick out the various tides to get an idea of what the actual contribution is to the current structure. Once we know that, then we can take that out and look at the rest of the contributions. We're seeing some unusual two-day period oscillations. We need to isolate those. Right now we're going back and forth between the various filtered portions of the current meter data and the spectra that we have and trying to find out what we're looking at when we see indications that there's a lot of energy in two days. We want to find out what was really going on in those two days. We have a student working on the wind data to see if we can tie that into some wind event to see if this is a large scale feature.

When we go on this cruise, we'll also be particularly interested in seeing where this convergence takes place. There is a doming of one boundary layer in the suspended sediment and we're very interested in seeing, with multiple crossing of the current there, if that is a coherent structure along the shelf, or if it's kind of patchy, or what it looks like. Then we have to go back and integrate data into our understanding of what the bottom boundary looks like. In some areas we get a cold spike coming up over the slope, and that affects the mixing process so we don't get an isothermal bottom layer, and that affects how the sediments move. That's what we're working on now. It seems to be coming along ok.

Amstutz: What do you use for wind data?

McGrail: We've got wind from one of the platforms [High Island 323]. It's got some problems. They are very, very high in the air (185 feet or something like that). So the speeds are very high. We are trying to get some more wind data from another platform out there that's a little closer. We're having a lot of difficulty with that. Apparently the anemometer and pressure sensor were placed immediately adjacent to the heloport and you get 100 mile an hour winds about twice a week.

Merrell: We have the charts from the station at A&M. The student who is working on it has an undergraduate degree in meteorology. We'll probably come out with some pretty good winds that are documented.

Amstutz: Are the meteorologists well represented at the seminars?

Merrell: No. But the meteorology student comes. At A&M they are mainly radar meteorologists; the only marine meteorologist isn't interested in this sort of stuff. I think we'll come out with some very good wind data for our purposes. We want to look at any catastrophic event.

McGrail: I want to mention that the wind events we're seeing have some important implications with respect to sediment transport. It is becoming very clear that the inertial oscillations that are associated with the impulsive wind events travel down through the water column much more rapidly than any organized structure. So you get a lot of oscillations near the bottom, particularly close to the banks. The inertial signal is amplified all the way to the bottom. The velocities are high enough to resuspend bottom sediment. It's funny, when you initially look at your spectra, the thing that leaps out at you is that apparently the diurnal tidal signal is enormous. But it really is two signals, the diurnal tide and the inertial current, which have about the same period, but the inertial current is norm-ally much stronger than the diurnal tidal current.

Amstutz: Are all of your velocity measures from current metres?

McGrail: No.

Merrell: We've had some dye studies.

McGrail: The dye studies that were done were on a small enough scale so that we're treating them as velocities. We're coming up with different types of graphics which we think will be most useful.

VI. BLM COMMENTS

Rogert Rogers, et al.

Rogers: We have covered the information meetings and pending modifications; I really don't know of any other business that we can inform you of or you can inform us of. Things seem to be going along real well.

McGrail: Did Carroll Day talk to you about you and I going over what instruments we were talking about in the pending contract modification?

Rogers: Yes, he mentioned it but I had already put together the memo explaining to him the instruments (as you relayed to us per our telephone conversation). So I think it will adequately inform him on why it's an equitable deal for all concerned.

VII. NECESSARY ACTION ITEMS FROM DISCUSSION
Bill Merrell

Merrell: As far as action items out of this, I see **we've** got to get the modification for the August meeting on the way. The PI's have to give **talks** at two meetings. We'll send BLM papers when we send them to journals. **We'll** send them to BLM at the same time; it takes so long to get them published, **you'll** have plenty of time to look them **over, so** you can be satisfied there's no management implications.

Avent: Manuscript?

Merrell: **We'll** just send the manuscript. We'll be sure that you get copies of it. We've been sending you at least some rough things even on our seminars, so you will have an idea of what we're doing.

Norman: Previously, the deal was that **we** sent an abstract. Do **you** want the paper?

Rogers: Well, **it's** varied, really. Dave sent a full-length manuscript recently.

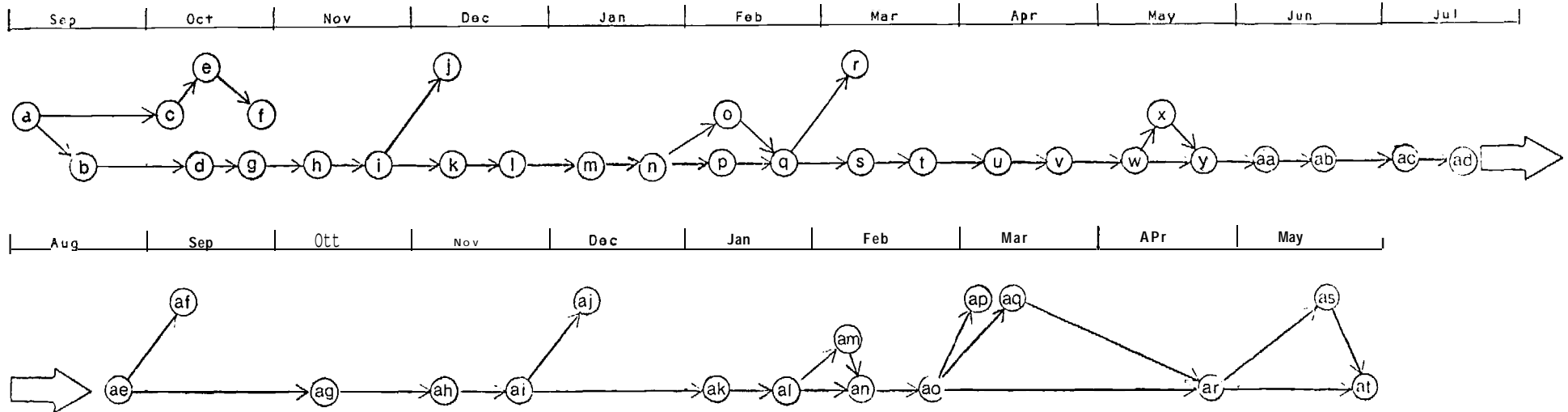
Merrell: Well, we want to keep you informed. We'll send the papers; I would like for you to have them anyway, from my point of view.

APPENDIX

AGENDA
BLM TERNARY MEETING
Contract AA851-CT1 -55 (RF4567)
SAN ANTONIO, TEXAS
FEBRUARY 18, 1982

- I. DISCUSSION OF AGENDA (Merrell)
- II. PROJECT OVERVIEW AND MANAGEMENT
 - Objectives and Progress (Merrell)
 - Final Report Outline
 - Project Timeline
 - Gulf-wide Meeting (May 12-13; Mobile, AL) (Herrig)
 - Information Transfer Meeting (Aug. 3-4; New Orleans, LA) (Herrig)
- III. BIOLOGY (Bright)
- IV. GEOLOGY (Rezak)
- V. SEDIMENT & CURRENTS DYNAMICS (McGrail)
- VI. BLM COMMENTS (Rogers, et. al.)
- VII. NECESSARY ACTION ITEMS FROM DISCUSSION (Merrell)

PERT DIAGRAM
BLM CONTRACT #AA851-CT1-55 [RF 4567]



Activity Key:

a - Start of project	m - mist Banks Seminar	ac - 13th Banks Seminar	ap - 6th Quarterly Summary Report to BLM
b - Initial seminar & final seminar series plan	n - 2nd Banks Seminar	ad - EFG Recap Seminar	ar - Draft Final Report & Executive Summary to BLM
c - Draft-Management Plan & Part Chart	o - Ternary meeting	ae - WFG Recap Seminar	as - Final Report to BLM
d - 1st EFG seminar	p - 3rd Banks Seminar	af - 4th Quarterly Summary Report to BLM	at - End of Contract
e - BLM approval - Management Plan & Pert Chart	q - 4th Banks Seminar	ag - 1st Categorization Seminar	
f - Final Management Plan & Pert Chart	r - 2nd Quarterly Summary Report to BLM	ah - 2nd Categorization Seminar	
g - 2nd EFG seminar	s - 5th Banks Seminar	ai - 3rd Categorization Seminar	
h - 3rd EFG seminar	t - 6th Banks Seminar	aj - 5th Quarterly Summary Report to BLM	
i - 1st WFG seminar	u - 7th Banks Seminar	ak - Draft-Final Report	
j - 1st Quarterly Summary Report to BLM	v - 8th Banks Seminar	al - Draft-Executive Summary	
k - 2nd WFG seminar	w - 9th Banks Seminar	am - Ternary meeting	
l - 3rd WFG seminar	x - Ternary meeting	an - Editing completed-Draft Final Report	
	y - 10th Banks Seminar	ao - Editing completed-Draft Executive Summary	
	z - 3rd Quarterly Summary Report to BLM		
	aa - 11th Banks Seminar		
	ab - 12th Banks Seminar		

TABLE 2
PROJECT MILESTONES

(° = task completed; † = estimated time of task completion)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Contract Start Date	°																				
Management Plan to BLM	°																				
PERT Diagram to BLM	°																				
Initial Seminar*	°																				
EFG Seminar (2)		°																			
EFG Seminar (1)			°																		
WFG Seminar (1)			°																		
WFG Seminar (2)				°																	
1st Quarterly Summary Report				°																	
Banks Seminar (2)**					°																
Ternary Meeting						t															
Banks Seminar (2)						t															
Banks Seminar (2)							t														
2nd Quarterly Summary Report†							t														
Banks Seminar (2)								t													
Banks Seminar (2)									t												
Ternary Meeting									t												
Banks Seminar (2)										t											
3rd Quarterly Summary Report										t											
Banks Seminar (1)											t										
EFG Recap (1)											t										
WFG Recap (1)												t									
4th Quarterly Summary Report†													t								
Categorization Seminar***														t							
Categorization Seminar (2)															t						
5th Quarterly Summary Report																t					
Text Executive Summary Due																					
(Draft)																	t				
Text Final Report† Due†																		t			
(Draft)																			t		
Editing Completed, Fin. Rpt																		t			
Ternary Meeting																			t		
Editing Completed, Exec. S.																			t		
Final Report &																					
Executive Summary to BLM																			t		
6th Quarterly Summary Report																				t	
BLM Comments																				t	
Approved Final Report and																					t
Executive Summary to BLM																					t
End Contract																					t

*The initial seminar was conducted for the discussion of each researchers hypotheses, methods of testing those hypotheses, and the contributions that each discipline can contribute to acceptance or rejection of those hypotheses.

**These seminars are devoted to 34 banks.

***The last four seminars are devoted to categorization of banks.

CONTRACT AA851-CT1 -55 (RF4567)
FINAL REPORT
SUMMARY OUTLINE

Title: REEFS AND BANKS OF THE NORTHWESTERN GULF OF MEXICO:

Subtitle: Their Geological, Physical, and Biological Dynamics

INTRODUCTION

The opening chapter will introduce the background, purpose, and significance of the study, summarize the kinds of observations on which conclusions are based, and briefly introduce a broad system for classifying the 32*reefs and banks which are the subject of the study (see Figure 1).

Background! and Purpose

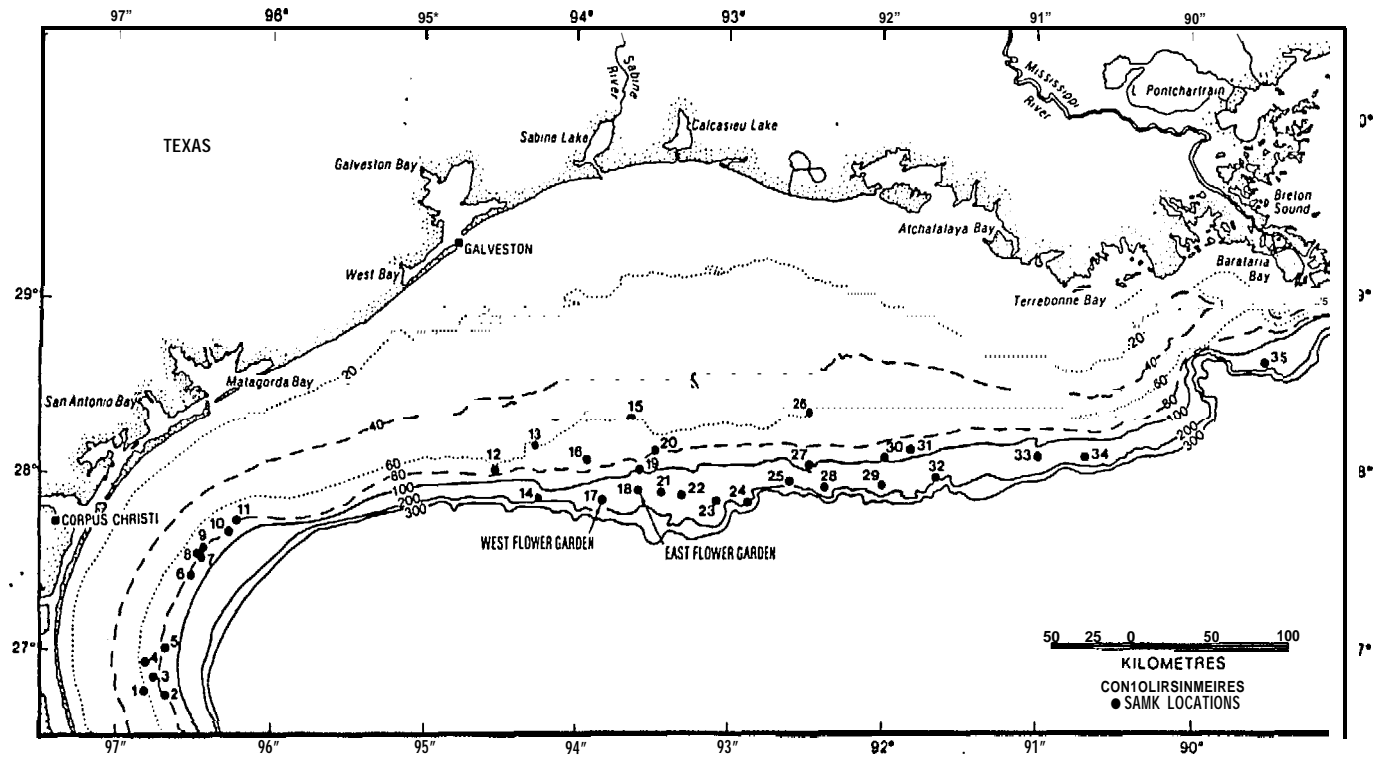
Through a synthesis of scientific data gathered under BLM contracts since 1975, we will explore the manners in which organisms, sediments, structure, and currents associated with these features are inter-related. The purpose of the study is to use observations and data from 32 reefs and banks to demonstrate and elucidate such relationships? showing how they function dynamically in the ecosystem.

Field Observations and Data Collection

The data base for this study comes from 32 reconnaissance, mapping, and sampling cruises, 1974-1981, to the banks. These data include over 400 hours of submersible observations (recorded on video tape), sub-bottom seismic profiles, hundreds of sediment samples and **biological** specimens, thousands of still photographs and slides, three years of data from moored current meters, and hydrographic data from

*Figure 1 shows 35 banks rather than 32 because special regions are shown for three banks (Big Adam/Small Adam, Hospital/North Hospital, Baker/South Baker).

FIGURE 1



- | | | | | |
|-----------------|------------------|----------------|-----------------|--------------|
| 1 Small Adam | 8 North Hospital | 15 Claypile | 22 Bright | 29 Parker |
| 2 Mysterious | 9 Aransas | 16 Coffee Lump | 23 Geyer | 30 Alderdice |
| 3 Blackfish | 10 Baker | 17 WFG | 24 Elvers | 31 Fishnet |
| 4 Big Adam Rock | 11 South Baker | 18 EFG | 25 18 Fathom | 32 Jakkula |
| 5 Dream | 12 32 Fathom | 19 MacNeil | 26 Sonnier | 33 Ewing |
| 6 Southern | 13 Stetson | 20 29 Fathom | 27 Bouma | 34 Diaphus |
| 7 Hospital | 14 Applebaum | 21 28 Fathom | 28 Rezak-Sidner | 35 Sackett |

over 300 stations. Supplementary data have also been obtained from a variety of sources.

The most detailed studies have been performed at the East and West Flower Garden Banks. Except for the Bermuda reefs, these are the northernmost tropical coral reefs in the northwest Atlantic. Proposed as National Marine Sanctuaries, these banks have been subjects of environmental controversy because of proposed development of substantial proven gas fields adjacent to them. The East Flower Garden Bank is also a unique marine habitat in that it harbors a natural brine seep issuing water five times more saline than seawater. The biotic community associated with the seep is of great contemporary interest, and several species are undoubtedly new to science. Our monitoring studies at the East Flower Garden began in 1976. Special studies at the Flower Garden Banks (1978-1981) include: time-series current meter data and seasonal hydrographic sampling; and studies of coral populations, recruitment, growth and mortality.

System of Classification

Central to the treatment of the 32 banks as an ecosystem is a single, broad system of classification. We are presently working with a classification based on the banks' positions on the shelf, their geographical locations, and their geology and biology. The three classes so identified are: 1) Mid-Shelf Siltstone/Claystone Banks, 2) Mid-Shelf Carbonate Banks, and 3) Shelf-Edge Carbonate Banks. A fourth class accounts for five intermediate or transitional banks that are anomalous in some way. These four classes provide a meaningful framework for discussing geological, physical, and biological characteristics of the 32 banks.

Plan of Organization

The body of the text will be divided into three main sections of four chapters each. We begin by describing the regional setting to provide a context for the study. The second section is a detailed treatment of the Flower Garden Banks, which together serve as a model for analysis of the other 30 banks. **The final** section uses this model and the broad classification system as a framework for discussing how the banks function dynamically as an ecosystem.

Part I: REGIONAL SETTING

This chapter will set forth a regional background for discussion of the bank **system**, opening with a description of the geological framework: the streams that are flowing into this portion of the Gulf, the distribution of sediments on the shelf, the general regional **structure**, and salt tectonics.

A general overview of what is known about shelf circulation will follow, based on our transects across the shelf, as well as on **satellite imagery**. The discussion of regional circulation will cover sources and distribution of suspended sediment across the shelf, transport trends, seasonal cycles of temperature and salinity, and fronts and classes of motion that take place (shelf waves, tides, inertial oscillation, effects of hurricanes). As a preliminary to discussion of individual banks, the section will also provide an overview of the local dynamics associated with flow around an obstacle.

The final portion will consider zoogeography of marine biota of the Outer Continental Shelf in the northwestern Gulf of Mexico, from the standpoint of their relationship to biota of other parts of the

Gulf of Mexico, Caribbean, and the North Atlantic continental shelf. This **will** include **an** overview of what is known about major benthic communities (such as shrimp grounds), characteristics of pelagic communities (fishes, etc.), and basic information on fishes and invertebrates on hard structures in the northwestern Gulf.

Part II: THE FLOWER GARDEN **BANKS**: A MODEL SYSTEM

Because of the complexities of these banks, a more intensive study has been conducted here than on any of the other banks in the northwestern Gulf of Mexico. The oceanographic characteristics of these banks cover the spectrum of properties found on banks and reefs in the northwestern Gulf. A description and analysis of the geological, physical, and biological characteristics of these **banks**, therefore, will establish a model from which we can extrapolate to the other banks.

The first chapter of this section will discuss the **sedimentology**, shallow geophysics, and **physiography** of the two banks, illustrated with a sedimentary facies map, structure and seafloor roughness maps, and a side-scan mosaic of the West Flower Garden Bank. Discussion of the shallow geophysics will include a description of both the physical structure (faults, doming, etc.) and unconformities in the subsurface, as well as an introduction **to** the East Flower Garden brine seep.

The chapter on circulation and sedimentary processes will depict the water masses present at the banks, beginning with a description of the seasonal flow around the banks, followed by scales of motion (shelf waves, inertial **oscillations**, tides, internal waves, surface gravity waves). Analysis of the effect of the bank on the flow will be based

on observations of shear stresses at the bottom and the resuspension of sediments.

Geological and physical properties of the banks provide the framework for a chapter describing the **benthic** communities at the Flower Garden Banks, including biotic zonation and community structure (species composition, population abundance, associations between species, and depth distribution of species and associations). These communities and their characteristics will be discussed in relation to similar communities in other parts of the Gulf of Mexico and Caribbean. Two special sections will provide detailed discussions of 1) the dynamics of coral populations at the crests of the two banks; and 2) the nature and function of biotic communities associated with the natural brine seep at the East Flower Garden Bank.

The final chapter in Part II will identify, describe, and discuss the inter-relationships of the geological, physical, and biological data: how these processes function together in the system and affect one another.

Part III: CHARACTERIZATION OF BANKS

This section will include separate chapters on geological, physical, and biological characteristics of the 32 banks, working within the framework of a single broad classification system. Several different systems of classification could be used, but, as indicated earlier, the one we have found most useful for discussing all three components is based on the banks' position on the shelf, their geographical location, and their geology and biology. Under this

system of classification, the banks are grouped as follows (see also, Figure 1):

I. Mid-Shelf Carbonate Reefs (located off South Texas)

Crest Depth 56-67 m:

Baker, South Baker

Aransas

Hospital

Southern

Dream

Crest Depth 60-70 m:

Big Adam Rock, Small Adam Rock

Blackfish Ridge

Mysterious

I. Mid-Shelf Siltstone/Claystone Banks (located off North Texas/Louisiana)

Crest Depth 25-30 m:

Claypile

Sonnier

Stetson

III. Shelf-Edge Carbonate Banks (extending from the Flower Gardens to the Mississippi River)

East Flower Garden

West Flower Garden

28 Fathom

Bright

Geyer

Elvers

18 Fathom

Ma cNei l

Bouma

Rezak-Sidner

Parker

Alderdice

Jakku la

Ewing

Diaphus

Sackett

IV. Transitional or Intermediate Banks

32 Fathom

Applebaum

Coffee Lump

29 Fathom

Fishnet

Banks in Classes **II**, **III**, and **IV** are associated with salt domes. Class I banks are submerged Pleistocene reefs that apparently grew on a carbonate platform. Specific banks will be chosen as representative types for discussion and illustration.

Within these broad classes, chapters on geology, circulation, and biology will identify appropriate sub-classes. For example, geologically **the** sediments **at** the banks are very similar, but the banks are different structurally.

A final chapter **will** provide a detailed synthesis/summary **of** the geological, physical, and biological characteristics of the banks, defining broad functional relationships and the dynamics of the bank system. Consideration will be given to "predictability" of characteristics of a bank, given a limited amount of information.